

## Description of geologic units in Richmond County

**al** *alluvium* (Holocene). Fine to coarse gravelly sand and sandy gravel, silt, and clay, light- to medium-gray and yellowish-gray. Deposited mainly in channel, point-bar, and flood-plain environments; includes sandy deposits of narrow estuarine beaches, and mud, muddy sand, and peat in swamps and in fresh- and brackish-water marshes bordering tidewater rivers. Grades into colluvium along steeper valley walls at margins of unit. Mostly Holocene but, locally, includes lowlying Pleistocene (?) terrace deposits. As much as 80 feet thick along major streams.

**QTu** *Quaternary and Tertiary deposits*, undifferentiated. Tab through Windsor Formations and alluvial/tidal prism deposits.

**Qtl** *Lynnhaven Member* (Johnson, 1976). Pebbly and cobbly, fine to coarse gray sand grades upward into clayey and silty fine sand and sandy silt; locally, at base of unit, medium to coarse cross-bedded sand and clayey silt containing abundant plant material fill channels cut into underlying stratigraphic units. Unit is surficial deposit of broad swale that is traceable southward from Norfolk; extensive low lands bounded on landward side by river-, bay-, and ocean-facing scarps having toe altitudes of 15 to 18 feet. Thickness is 0 to 20 feet.

**Qtp** *Poquoson Member* (Johnson, 1976). Medium to coarse, pebbly sand grades upward into clayey fine sand and silt, light- to medium-gray; underlies ridge and swale topography (altitude ranges from sea level to 11 feet) along the margin of Chesapeake Bay and in the lower and middle parts of Coastal Plain rivers. Thickness is 0 to 15 feet.

**Qtlp** *Lynnhaven and Poquoson Members*, undifferentiated.

**Qts** *Sedgefield Member* (Johnson, 1976). Pebbly to bouldery, clayey sand and fine to medium, shelly sand that grades upward into sandy and clayey silt; locally channel fill at base of unit includes as much as 50 feet of fine to coarse, cross-bedded sand and clayey silt and peat containing in-situ tree stumps. Sandy bay facies commonly contains *Crassostrea biostromes*, *Mercenaria*, *Anadara*, *Polynices*, *Ensis*, and other mollusks. Specimens of the coral *Astrangia* have yielded estimated uranium-series ages averaging  $71,000 \pm 7,000$  yrs B.P. (Mixon and others, 1982). Unit constitutes surficial deposit to river and coast-parallel plains (altitude 20-30 feet) bounded on landward side by Suffolk and Harpersville scarps. Thickness is 0 to 50 feet.

**Qsh** *Shirley Formation* (middle Pleistocene, Johnson and Berquist, 1989). Light- to dark-gray, bluish-gray and brown sand, gravel, silt, clay, and peat. Constitutes surficial deposits of riverine terraces and relict baymouth barriers and bay-floor plains (altitude 35-45 feet) inset below depositional surfaces of the Chuckatuck

Formation (Johnson and Peebles, 1984). Upper part of unit is truncated on the east by the Suffolk and Harpersville scarps; locally, lower part occurs east and west of scarps. Fluvial-estuarine facies comprises (1) a lower pebble to boulder sand overlain by (2) fine to coarse sand interbedded with peat and clayey silt rich in organic material, including in-situ tree stumps and leaves and seeds of cypress, oak, and hickory, which grades upward to (3) medium- to thick-bedded, clayey and sandy silt and silty clay. Marginal-matrix facies in lower James River and lowermost Rappahannock River areas is silty, fine-grained sand and sandy silt containing *Crassostrea virginica*, *Mulinia*, *Noetia*, *Mercenaria*, and other mollusks. *Astrangia* from lower Rappahannock River area has yielded a uranium-series age of  $184,000 \pm 20,000$  yrs B.P. (Mixon and others, 1982). Thickness is 0 to 80 feet.

**QTW Windsor Formation** (lower Pleistocene or upper Pliocene, Coch, 1968). Gray and yellowish- to reddish-brown sand, gravel, silt, and clay. Constitutes surficial deposits of extensive plain (altitude 85-95 feet.) seaward of Surry scarp and of coeval, fluvial-estuarine terraces west of scarp. Fining upward sequence beneath plain consists of a basal pebbly sand grading upward into cross-bedded, quartzose sand and massive, clayey silt and silty clay; lower and upper parts of sequence were deposited, respectively, in shallow-marine or open-bay and restricted-bay or lagoonal environments. In terraces west of Surry scarp, fluvial-estuarine deposits comprise muddy, coarse, trough cross-bedded sand and gravel grading upward to sandy silt and clay. Thickness is 0 to 40 feet.

**Tm Moorings unit** of Oaks and Coch (1973) (upper Pliocene). White, light-gray, and grayish-yellow quartzose sand and gray to grayish-brown clayey silt and silty clay. Constitutes discontinuous linear body along and just west of the Surry scarp; depositional surfaces range in altitude from 130 feet along slightly higher, ridge-like topography at scarp to about 110 feet west of scarp. Eastern facies of unit is unfossiliferous, massive to cross-laminated, moderately well-sorted, fine sand believed to have been deposited in beach and near-shore environments. Upper part of fine sand facies interfingers westward with massive, bioturbated clay and silt deposited in a lagoon or shallow bay. Thickness is as much as 30 feet.

**Tb1 / Tb2 Bacons Castle Formation** (upper Pliocene, Coch, 1965). Gray, yellowish-orange, and reddish-brown sand, gravel, silt, and clay; constitutes surficial deposits of high plain extending from Richmond, eastward to the Surry scarp. Unit is subdivided into two members: Tb1, massive to thick-bedded pebble and cobble gravel grading upward into cross-bedded, pebbly sand and sandy and clayey silt, and Tb2, predominantly thin-bedded and laminated clayey silt and silty fine-grained sand. Tb2 is characterized by flaser, wavy, and lenticular bedding and rare to common clay-lined burrows including *Ophiomorpha nodosa*. Thickness is 0 to 70 feet.

**Tc Chesapeake Group** (upper Pliocene to lower Miocene, Darton, 1891). Fine- to coarse-grained, quartzose sand, silt, and clay; variably shelly and diatomaceous, deposited mainly in shallow, inner- and middle-shelf waters. Ages of units based on studies of foraminiferal, nannofossil, diatom, and molluscan assemblages in Virginia and adjacent states (Andrews, 1988; Gibson, 1983; Gibson and others, 1980; Poag, 1989; Ward and Blackwelder, 1980; Ward and Krafft, 1984). Includes the following formations, from youngest to oldest:

**Chowan River Formation** (upper Pliocene, Blackwelder, 1981). Gray to dusky blue-green sand, fine- to medium-grained, clayey and silty, commonly very shelly; grades laterally into laminated, silty clay and upward into cross-bedded, biofragmental sand, clayey silt, and silty clay. Discontinuous pebbly to bouldery sand at very irregular base of unit. Mollusks include *Glycymeris hummi*, *Noetia carolinensis*, and *Carolinapecten eboreus bertiensis*. Thickness is 0 to 50 feet. Recognized only in southeasternmost Virginia and North Carolina.

**Yorktown Formation** (lower upper Pliocene to lower Pliocene, Clark and Miller, 1906). Bluish-gray and brownish-yellow sand, fine- to coarse-grained, in part glauconitic and phosphatic, commonly very shelly, interbedded with sandy and silty blue-gray clay. In lower York and James River basins, unit includes cross-bedded shell hash. Mollusks include *Glycymeris subovata*, *Chesapecten jeffersonius*, *Chesapecten madisonius*, *Mercenaria tridacnoides*, *Panopea reflexa*. Coarse-grained sand and gravel facies of the Yorktown in updip areas is mapped separately as unit psg. Thickness is 0 to 150 feet.

**Eastover Formation** (upper Miocene, Ward and Blackwelder, 1980). Dark-gray to bluish-gray, muddy sand, very fine to fine, micaceous, interbedded with sandy silt and clay. Lower part of unit is dominantly medium- to very-thin-bedded and laminated silt and clay interbedded with very-fine sand, lenticular and wavy bedding common; upper part is mainly very-fine- to fine-grained sand containing abundant clay laminae. Typical mollusks include *Chesapecten middlesexensis*, *Marvocrassatella surryensis*, *Glossus fraterna*. Thickness is 0 to 270 feet.

**St. Marys Formation** (upper and middle Miocene, Shattuck, 1902). Bluish- to pinkish-gray, muddy, very-fine sand and sandy clay-silt, locally abundantly shelly. *Chesapecten santamaria*, *Buccinofusus parilis*, and *Ecphora gardnerae* are characteristic mollusks. Occurs northeast of Mattaponi River. Thickness is 0 to 40 feet.

**Choptank Formation** (middle Miocene, Shattuck, 1902). Olive-gray sand, fine to very-fine, clayey and silty, shelly, and diatomaceous clay-silt; commonly forms fining-upward sequences. Mollusks include *Chesapecten nefrens*, *Mercenaria cuneata*, *Ecphora meganae*. Thickness is 0 to 50 feet.

**Calvert Formation** (middle and lower Miocene, Shattuck, 1902). Commonly consists of 2 to 7 fining-upward sequences. Each sequence includes a light to dark olive-gray basal sand, very fine to fine, clayey and silty, very sparsely to abundantly shelly; grades upward to sandy, diatomaceous clay-silt and diatomite. Typical molluscs include *Chesapecten coccymelus*, *Crassatella melinus*, *Ecphora tricostata*. Thickness is 0 to 600 feet.

**psg** *Pliocene sand and gravel*. Interbedded yellowish-orange to reddish-brown gravelly sand, sandy gravel, and fine to coarse sand, poorly to well-sorted, cross-bedded in part, includes lesser amounts of clay and silt in thin to medium beds. Commonly caps drainage divides (altitude 250-170 feet) in western part of Coastal Plain. Lower part of unit, showing flaser and lenticular bedding and containing rare to abundant *Ophiomorpha nodosa*, represents deposition in marginal-marine environments and is, in part, a nearshore equivalent of the more downdip, marine facies of the Yorktown Formation. In the northern part of the Coastal Plain, the more poorly sorted and less cleanly washed upper part of unit, which lacks fossils, comprises fluvial-deltaic sediments that prograded eastward across the shelf during a regressive phase of the Yorktown. To the south, the upper part of unit is massively bedded clayey sand in places containing heavy mineral concentrations that average 8 percent or more; the sands are nearshore, beach and dune origin; interstitial clay was derived, in part, from in-situ weathering of feldspar sand. Thickness is 0 to 50 feet.

(From Virginia Division of Mineral Resources, 2003, Digital representation of the 1993 geologic map of Virginia: Virginia Division of Mineral Resources Publication 174, compact disc.)